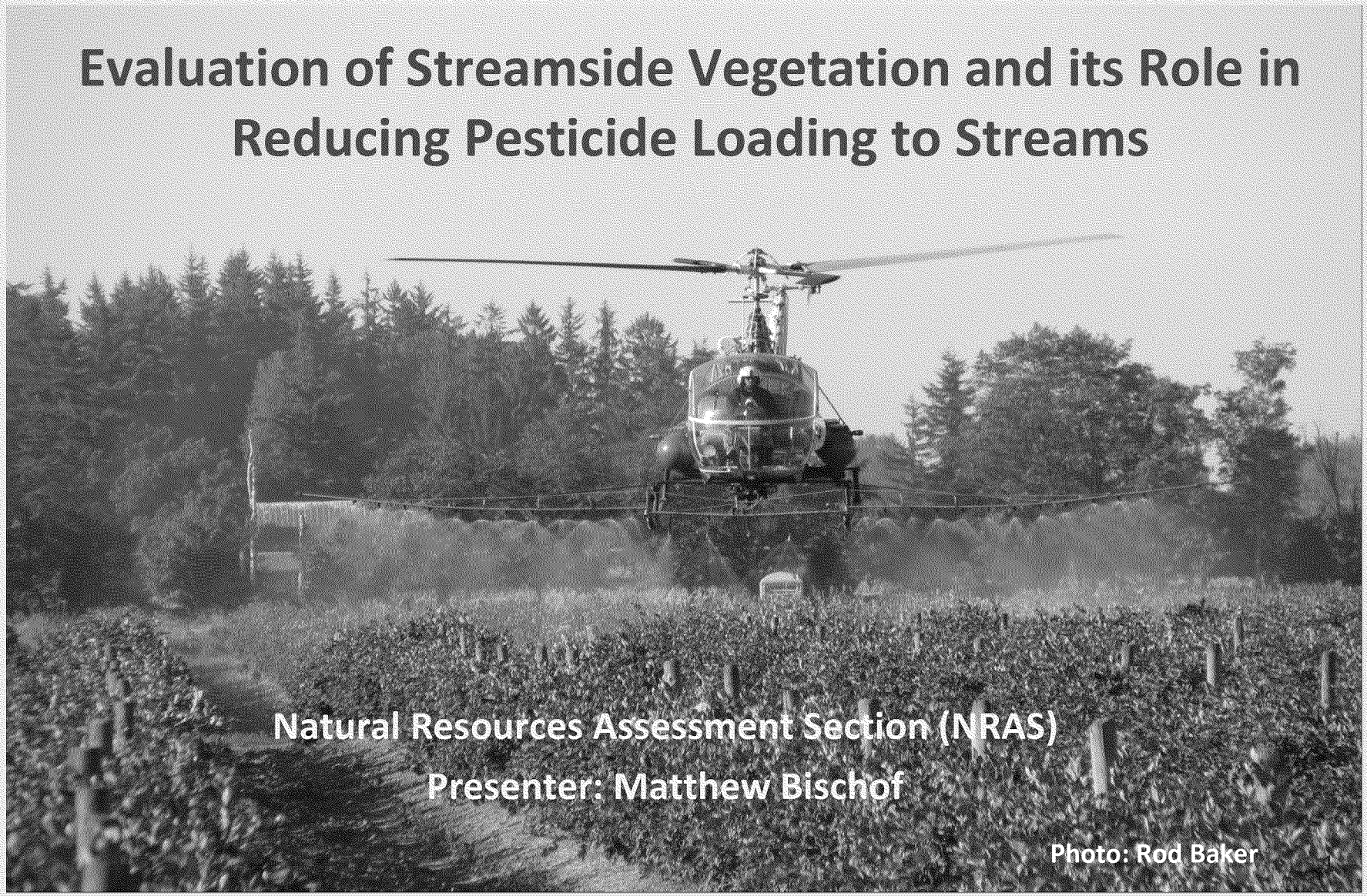
Washington State Department of Agriculture

Evaluation of Streamside Vegetation and its Role in Reducing Pesticide Loading to Streams



Natural Resources Assessment Section (NRAS)

Presenter: Matthew Bischof

Photo: Rod Baker

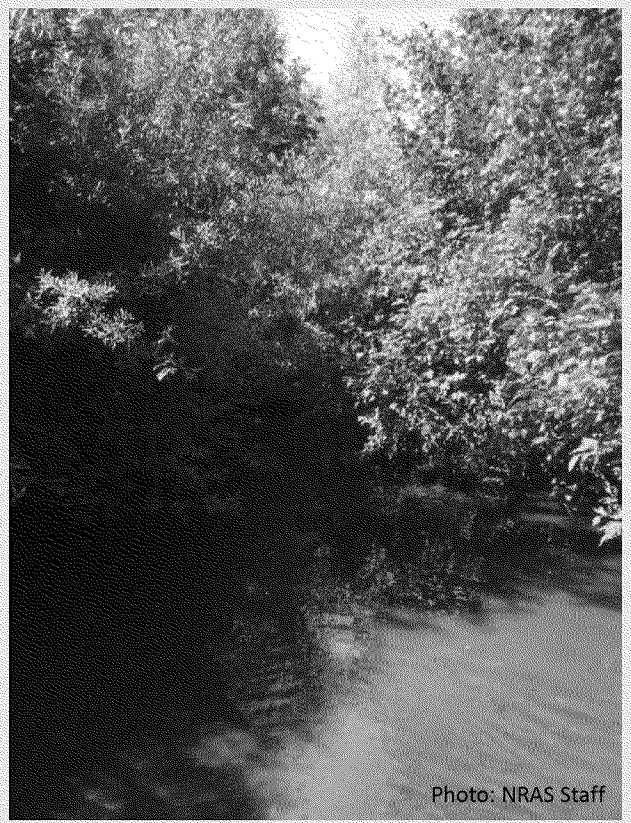
Collaborative Effort

NMFS + NRAS = Initial project concept

Study Objective: **Determine how effective streamside vegetation is at reducing pesticide loading to streams.**

Study design contributing factors:

- Upcoming BiOp for Malathion
- Spotted Wing Drosophila (SWD) pest pressure
- High density of possible sites
- Opportunity for site specific data



FT1 (Vegetated Site)

Collaborative Effort

In 2014, NRAS Partnered with:

- NMFS (NOAA)
- EFED (EPA)
- Whatcom Conservation Distric
- Washington State Blueberry Co
- Agronomists with Whatcom Fa

UD1-Control Site Photo: NRAS Staff

- Aerial applicators
- Pesticide Registrants
- Plus many others along the way

Study Design

- **Control Sites** - without dense woody vegetation
- **Vegetated Sites** - with dense woody vegetation - 4 to 10 meters wide
- Sites
  - 2 control
  - 3 vegetated
- Monitored 8 events
  - 4 control
  - 4 vegetated
- Single sided and double sided sites

Whatcom County, WA

Photo: NRAS Staff

Study Design-Challenges

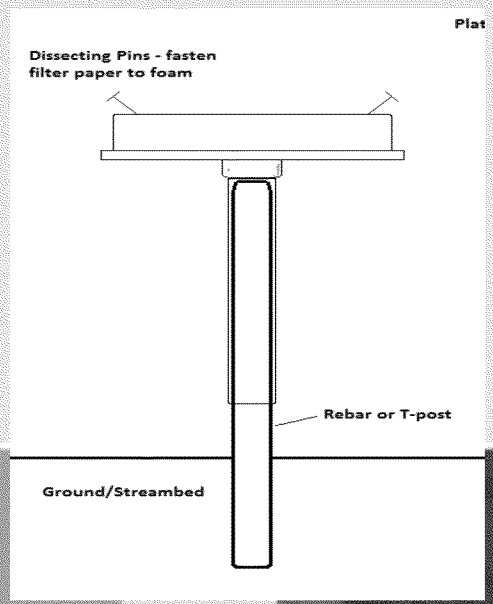
- Weather dependent
  - No schedule
  - Hot, dry year
  - Shortened harvest season
- Site access
- Labor intensive
- Newly developed standard operating procedures

Study Design

Vegetation Assessment, 6 transects per site

- Instream
  - Geometry
  - Shading
  - Habitat
  - Gen. Water Chem
- Upland
  - Width of buffer

Study design –Sample collection



Depositional Samples

- Field edge
- Vegetation edge
- Water

Single Sided depositional placement

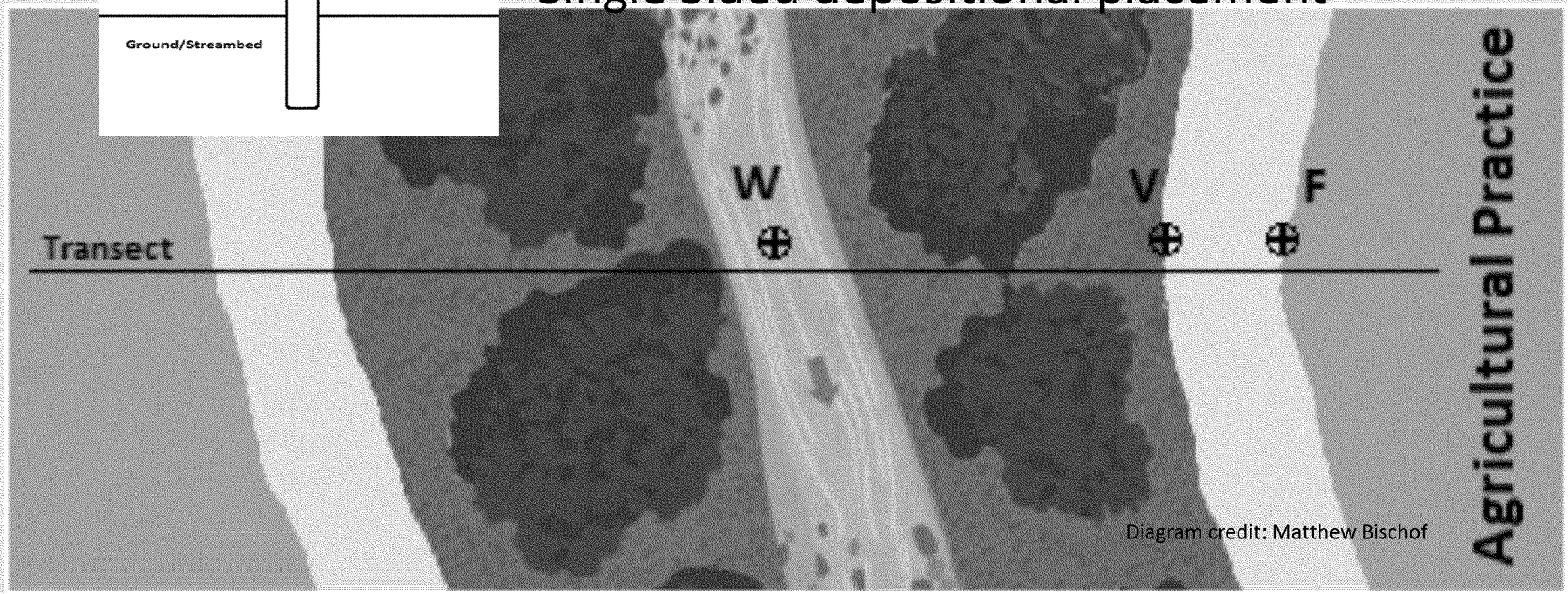


Diagram credit: Matthew Bischof

Depositional Samplers

Photo: NRAS Staff

Study Design- Sample Collection

Water Samples

-Standing water; Grab before and after

-Flowing water; composite upstream and downstream

Photo: NRAS Staff

Auto Sampler + Depositional Sampler

Double Sided Transect Layout

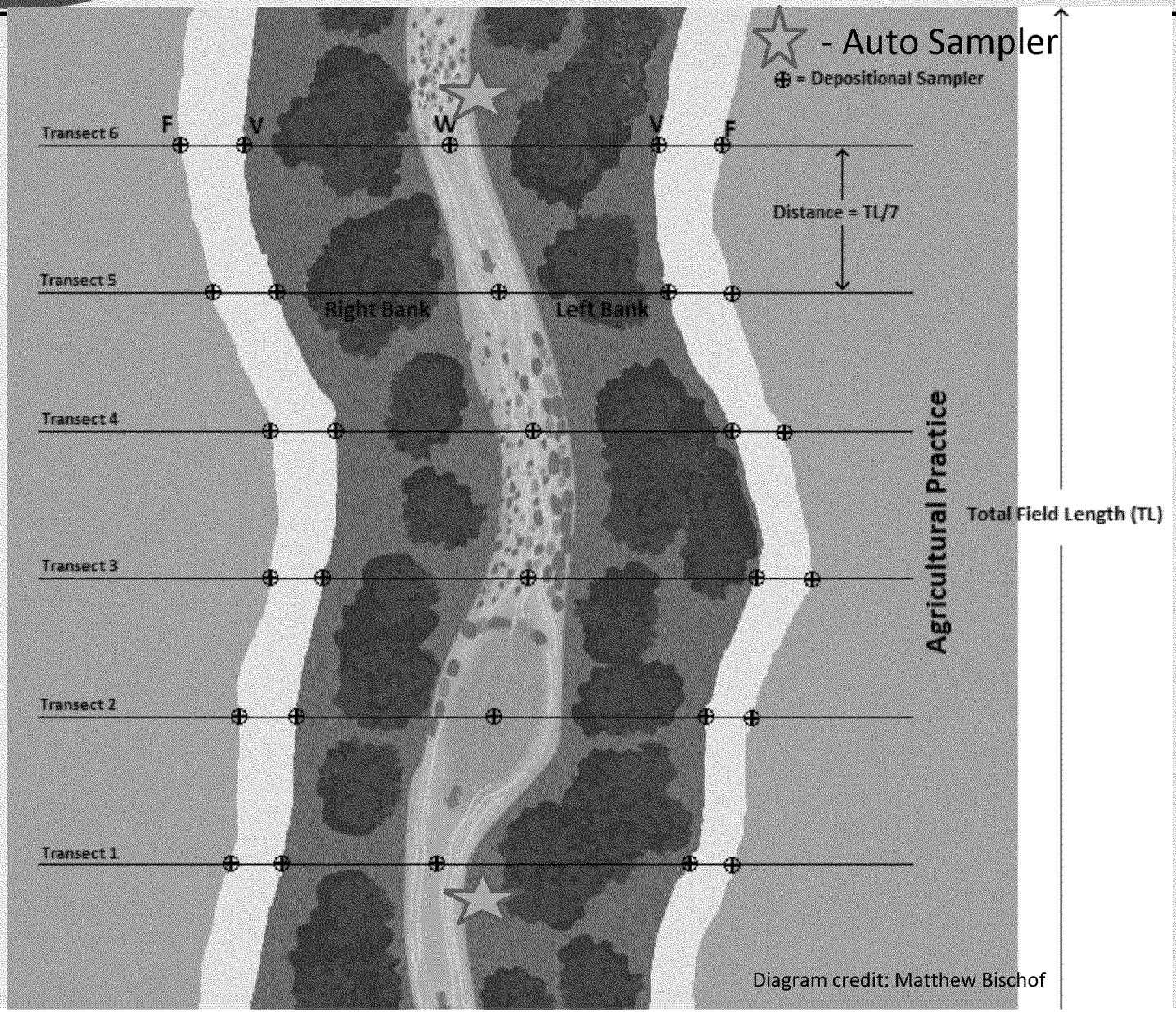


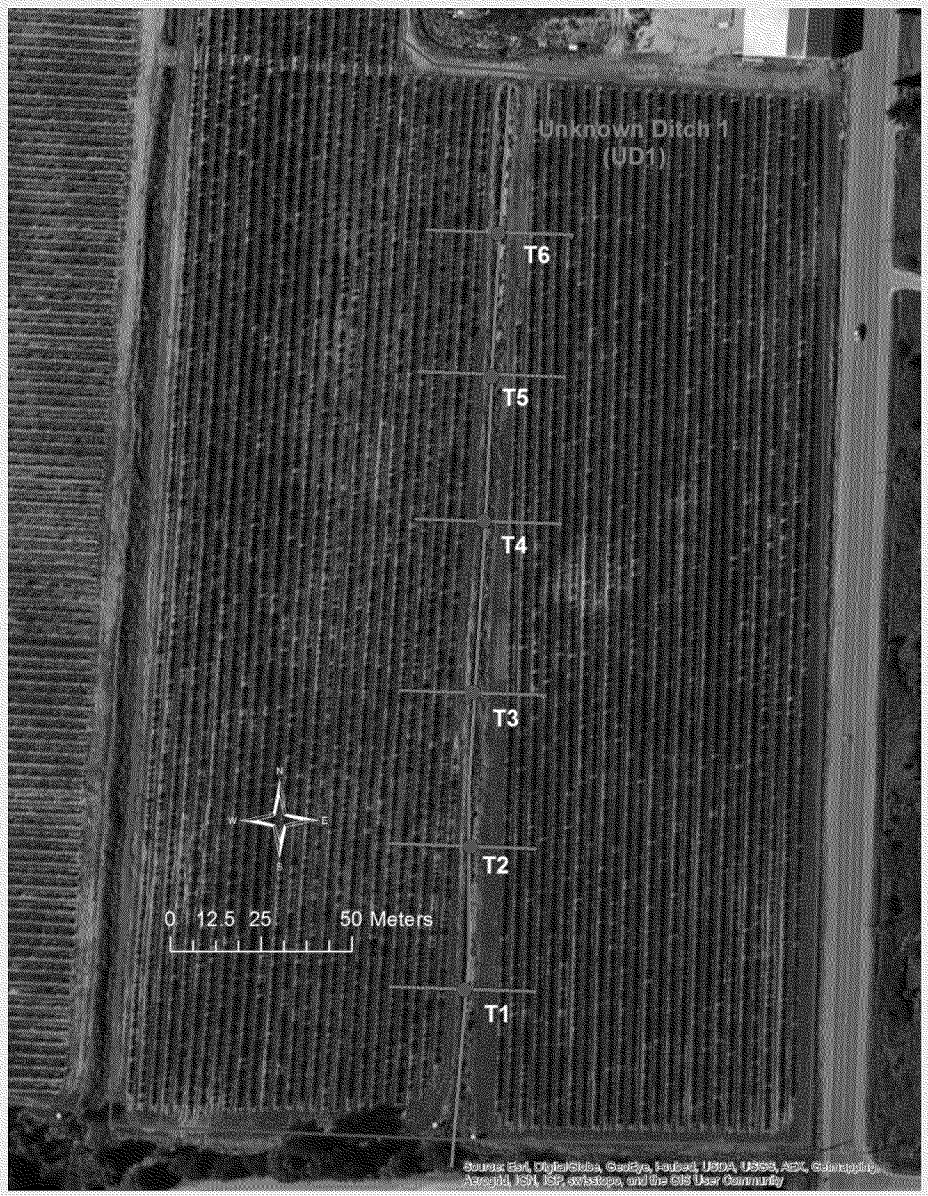
Diagram credit: Matthew Bischof

Study Design

Weather Station

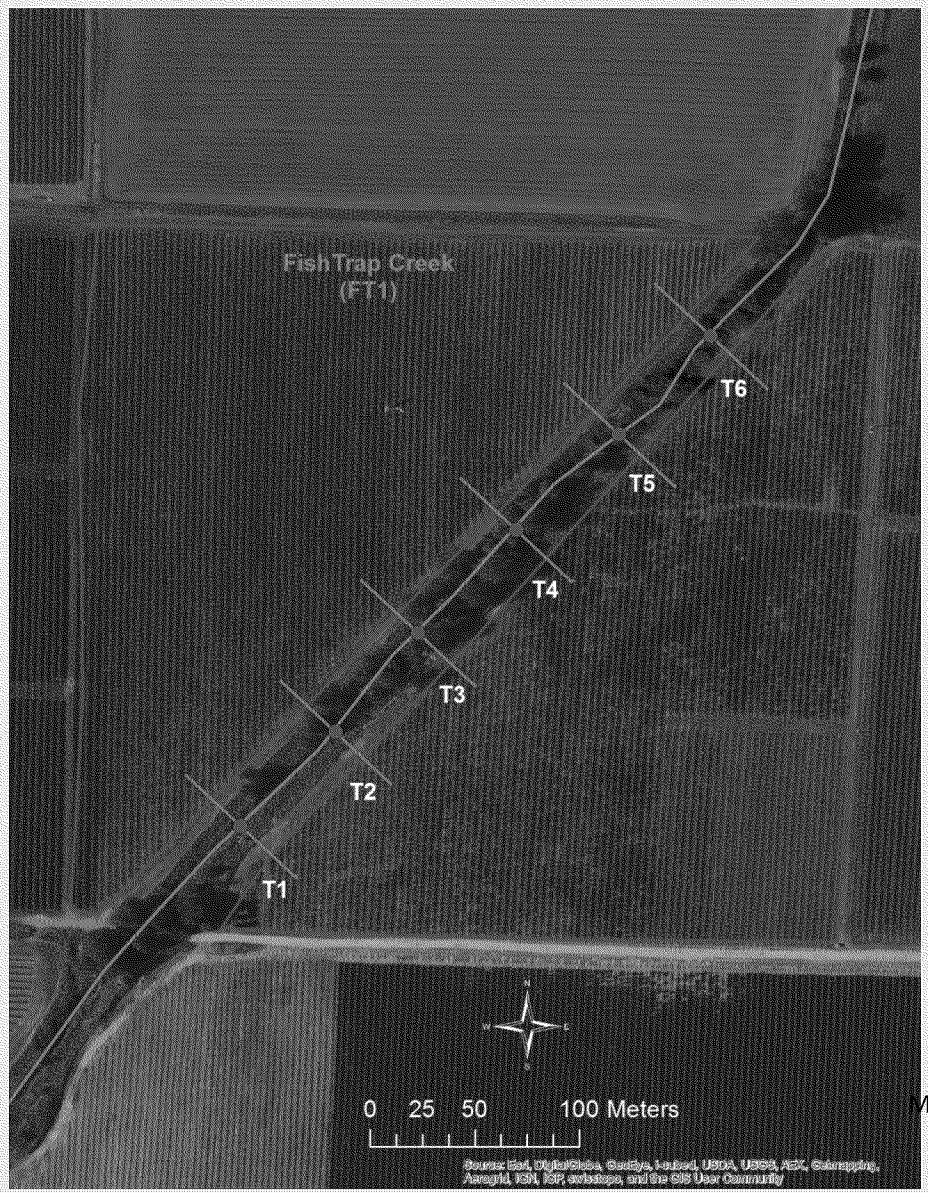
- Wind speed & direction
- Temperature
- Humidity
- Solar Radiation
  - Logged every – 30 sec

Transect Layout – UD1



Map credit: Joel Demory

Transect Layout – FT1

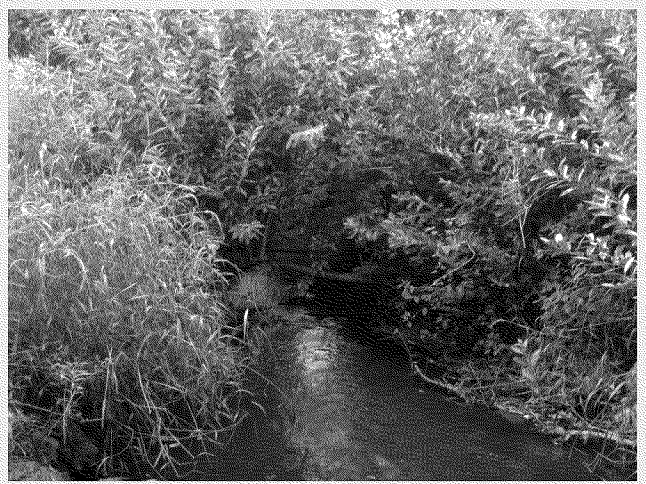


Map credit Joel Demory

Site Comparison

Averages for Field and Vegetation Measurements

Site Type	Mean Vegetated Sites	Mean Control Sites
Canopy Angle (°)	71.79	0
Instream Canopy Cover (%)	85.76	45.72
In Vegetation Canopy Cover (%)	95.62	0
Bankfull Width (m)	6.66	4.86
Buffer Width (m)	6.61	n/a
Buffer Height (m)	5.72	n/a
Water to Veg Distance (m)	8.22	2.84
Veg to Field Distance (m)	8.3	3.59



Upstream of FM2 (Vegetated Site)

Preliminary Water Results

Site Type	Samples	Event	Sample Type	Average (µg/L)	Max (µg/L)	Detections
Control	UD1	1	Grab – Before	< 0.05	< 0.05	0 of 6
			Grab – After	**4.14**	**7.1**	7 of 7
		2	Grab – Before	0.08	0.21	3 of 6
			Grab – After	**3.45**	**7.8**	6 of 6
Vegetated	FM1	1	Composite - Upstream	0.05	0.064	1 of 4
			Composite – Downstream	0.06	0.069	3 of 4
Vegetated	FM2	1	Composite - Upstream	< 0.05	< 0.05	0 of 4
			Composite – Downstream	0.07	0.11	2 of 4
		2	Composite - Upstream	< 0.05	< 0.05	0 of 4
			Composite – Downstream	< 0.05	< 0.05	0 of 4
Vegetated	FT1	1	Grab – Before	< 0.05	< 0.05	0 of 6
			Grab – After	0.14	0.28	6 of 6
			Composite - Upstream	0.09	0.13	3 of 4
			Composite – Downstream	0.27	0.29	4 of 4

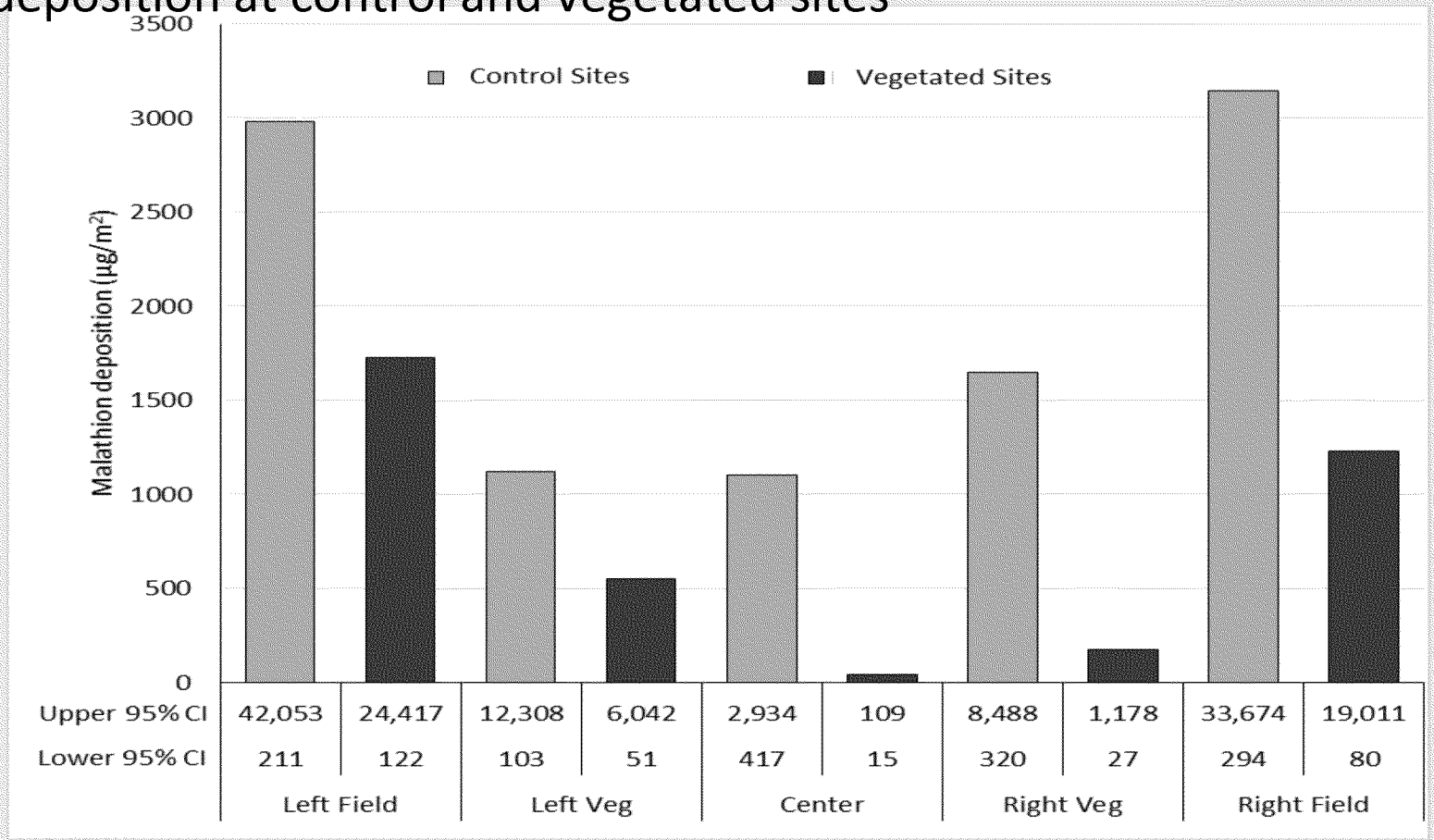
Endangered Species Level of Concern for Malathion: 1.65 µg/L

Deposition Results

- Todd Coffey, Statistician @ WSU
- Log_{10} transformed
- Was there a difference between vegetated and control sites?
- What buffer characteristics had an effect on malathion deposition and by how much?

Deposition Results

- Linear mixed model used
- From the mixed model, here are mean estimates of malathion deposition at control and vegetated sites



Deposition results

Univariable analysis of vegetation characteristics and instream malathion deposition

Model	Parameter modeled	Expected change in $\log_{10}$ of instream malathion deposition*	p-value
1	Canopy cover (average of stream and bank canopy cover) (%)	-0.015	0.002
2	Distance between F and V (m)	-0.256	0.008
3	Canopy angle (°)	-0.018	0.0002
4	Distance between F and W (m)	-0.108	0.032

* This estimate represents the expected change in $\log_{10}$ of instream malathion deposition resulting from a 1-unit increase in the corresponding parameter

To answer the second question, these four variables were significantly inversely related to malathion deposition

Deposition Results

Two-covariate models

Model	Parameters modeled	Expected change in $\log_{10}$ of instream malathion deposition*	p-value
1	Canopy cover (average of stream and bank canopy cover) (%),	-0.011	0.005
	Distance between field-edge and vegetation-edge (m)	-0.167	0.028
2	Canopy angle (°),	-0.014	0.002
	Distance between field-edge and vegetation-edge (m)	-0.086	0.32
3	Canopy cover (average of stream and bank canopy cover) (%),	-0.011	0.021
	Distance between field-edge and center water (m)	-0.047	0.30
4	Canopy angle (°),	-0.017	0.005
	Distance between field-edge and center water (m)	-0.010	0.78

Deposition Results

Two-covariate models

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Deposition Results

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An average additional 0.1 decrease in $\log_{10}$ of instream malathion deposition (approximately 26% lower) could be reached by either:

- Increasing the F – V distance by an additional 0.6 m

or

- Increasing the canopy cover by an additional 9%.

Conclusion

- Hypothesis supported (Dense woody vegetation reduces instream deposition) Malathion deposition was significantly reduced at vegetated sites.
  - Canopy Cover and Distance were shown as significant factors in reducing deposition.
- Our recommendation: the presence of vegetative buffers should be considered when determining pesticide application no-spray buffers

Next time:

- Increase sample size
- Weight site selection more heavily on distances

Win-Win Situation for Everyone

- "reduced set of no-spray buffers or not have to follow the no-spray buffer requirements" (NMFS draft BiOp, May 2013)
- Maximize economic benefit and maintain low exposure risk
- Opens the door for similar thinking in future pesticide registrations
- Producers get credit where credit is due
- Environmental benefits; lower water temperatures, reduced runoff/nutrient loading.

Acknowledgements

- Blueberry Producers in Whatcom
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Questions?

Future work:

- Model comparison where appropriate, AgDisp
- Further composite water sample analysis
- Repeat!?

Deposition Results Con't

Percent reduction from field-edge(F) to water (W) for all applications